

# (12) UK Patent Application (19) GB (11) 2 157 557A

(43) Application published 30 Oct 1985

(21) Application No 8508231

(22) Date of filing 29 Mar 1985

(30) Priority data

(31) 8409977

(32) 17 Apr 1984

(33) GB

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(51) INT CL<sup>4</sup>

A47C 1/02 A61G 5/00

(52) Domestic classification

A4L 1004 104 1101 1102 111 112 113 702 BRE

U1S 1738 1827 A4L

(56) Documents cited

None

(58) Field of search

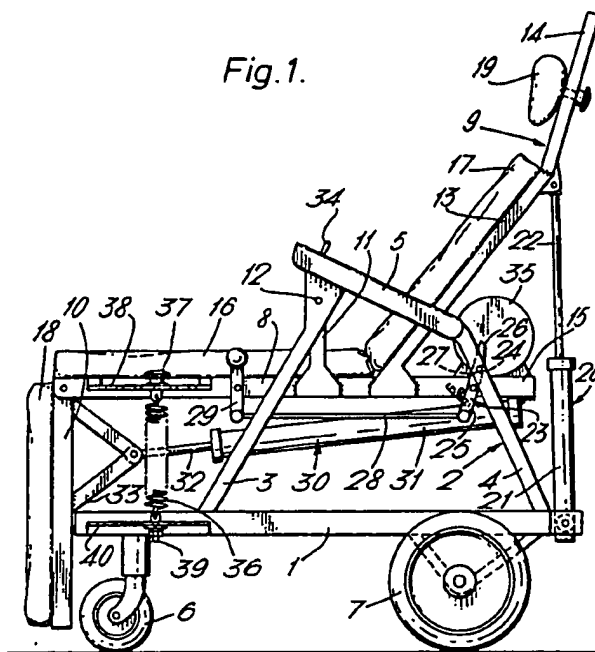
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## (54) Adjustable reclining chair

(57) An adjustable reclining chair comprises a support frame (1, 2) and a seat which is pivotally mounted on the support frame so that it can swing about a pivot axis (12). A combined back and head rest (9) is fixed to seat portion (8), to which a leg rest (10) is articulated. The leg rest can be raised by extension of pneumatic ram (30) operated by a controller (34). A further pneumatic ram (20) acts between the support frame 1 and the back and head rest (9), and extension of this ram pivots the seat to an upright position in which the seat portion (8) is substantially horizontal. Catches (23) automatically engage to hold the seat in this position until they are released and a second controller (34) is operated to exhaust the ram (20), whereupon the seat tilts backwards to a reclined position. A cylinder of compressed air for supplying the rams (20) and (30) is carried on an extension (15) of the seat portion.

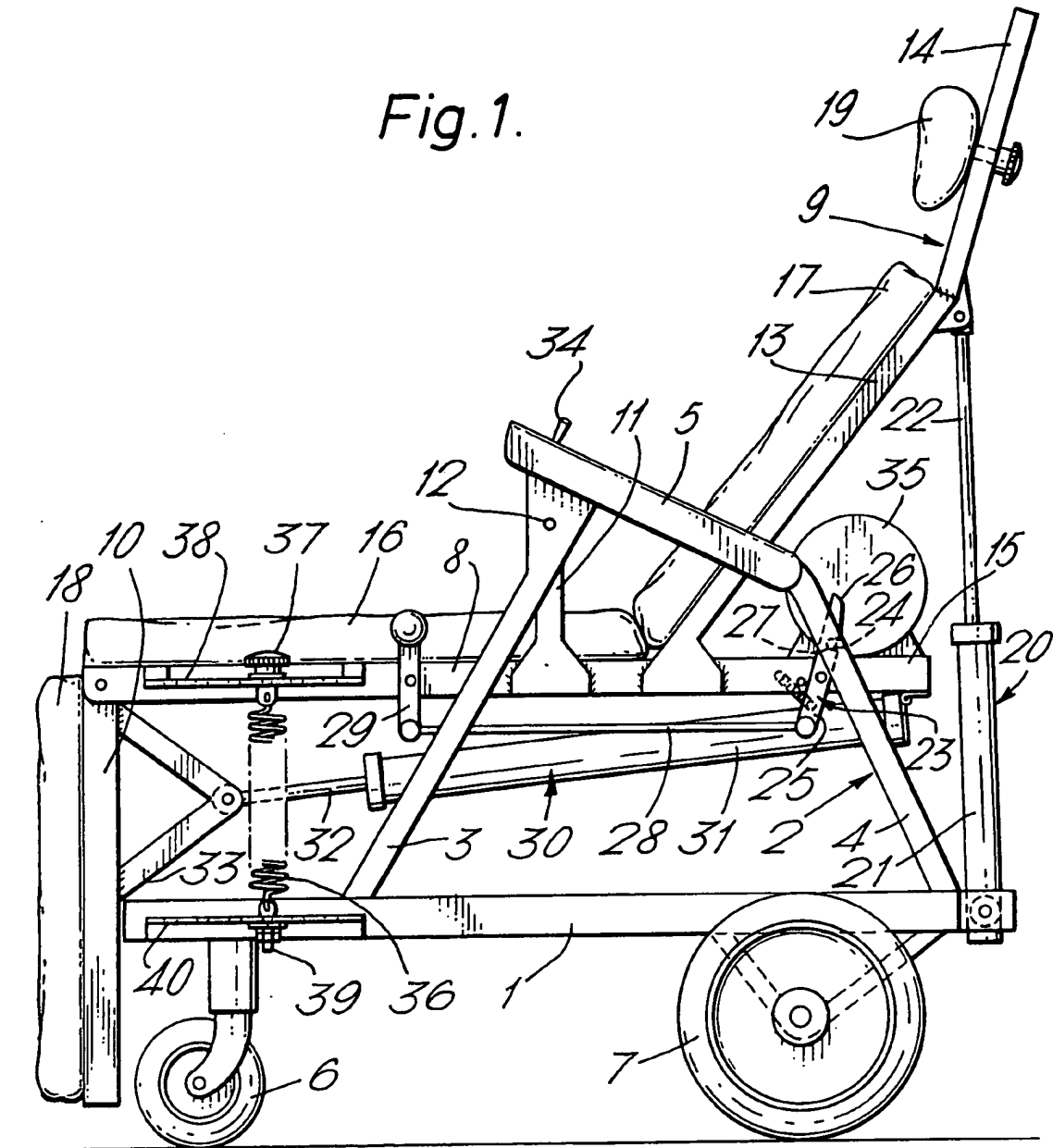
Fig.1.

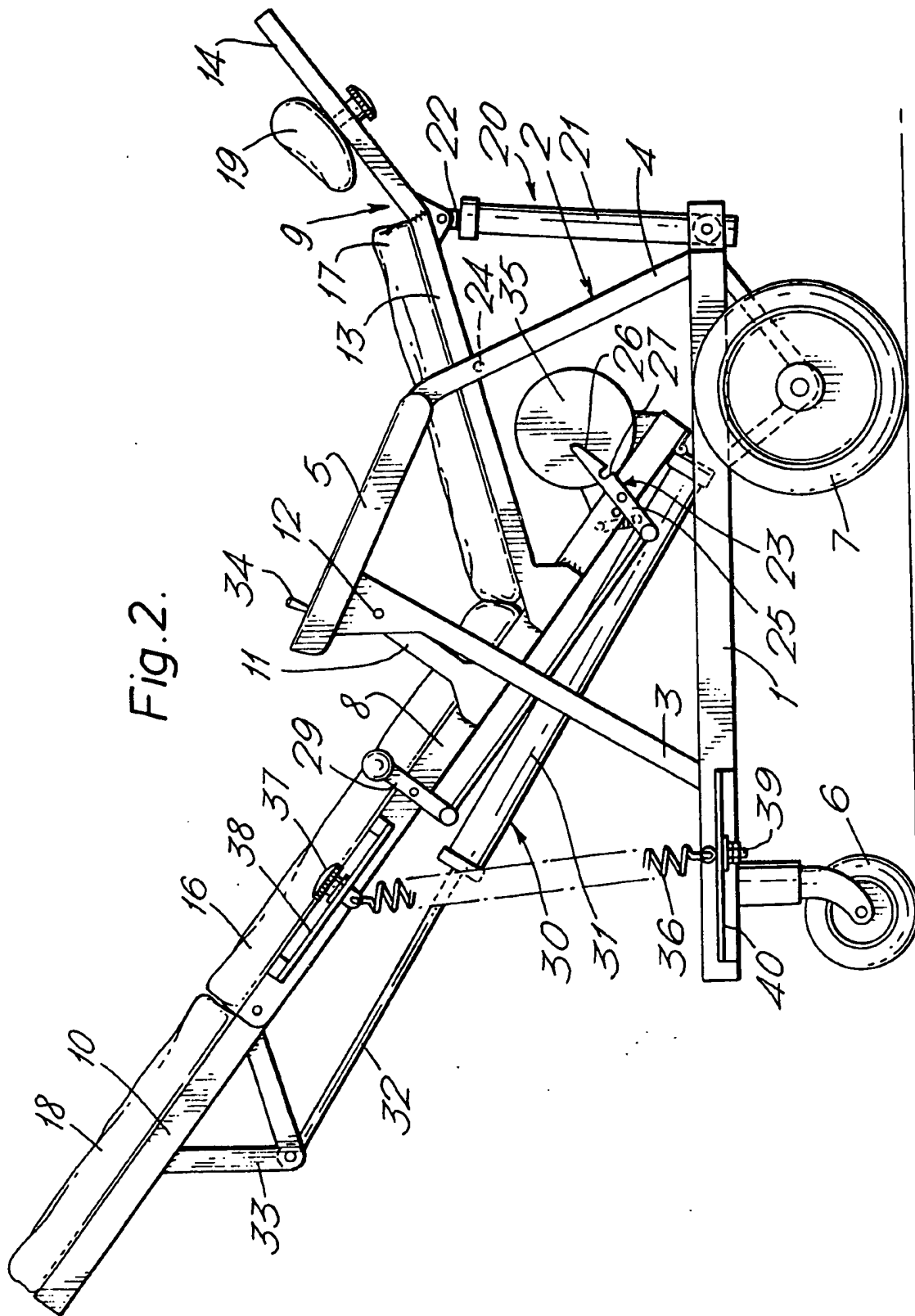


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The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

Fig. 1.





## SPECIFICATION

## Adjustable Reclining Chair

This invention relates to an adjustable reclining chair.

- 5 At present such chairs are either electrically operated or comprise a system of mechanical linkages to maintain counter-balance, but in either case are extremely heavy and expensive. Furthermore, the mechanically operated chairs, in some positions, require considerable effort to adjust the position. The aim of the present invention is to provide an adjustable reclining chair which is easy and requires little effort to operate, can be made inexpensively with lightweight materials, and which is therefore particularly suitable for disabled and elderly people.

- To this end, according to the invention, an adjustable reclining chair comprises a seat portion which is pivotally mounted on a support frame so that the seat portion can rock about the pivot axis, a back and head rest connected to the seat portion, a first pneumatic ram acting between the frame and the back and head rest, a leg rest articulated to the seat portion and acted on by a second pneumatic ram, and control means for controlling the supply and release of compressed air to and from the first and second rams independently of each other.

- In use, a person will sit in the chair with the second ram retracted to lower the leg rest, and the first ram extended to hold the back and head rest up and the seat portion substantially horizontal. If the person then leans back and operates the control means to allow air to escape from the first ram, providing the centre of gravity of the seated person is behind the pivot axis, the seat (i.e. the seat portion together with the leg rest and the back and head rest) will recline, tilting rearwards about the pivot axis as the first ram retracts at a rate determined by the escape of air. Switching the control means to the supply position enables compressed air to be supplied to extend the first ram and raise the seat back up again, and the seat can be stopped in any desired position simply by operating the control means to stop the escape or supply of air to the first ram. Similarly, the leg rest can be raised, lowered, or stopped relative to the seat portion by operating the control means to suitably control the second ram.

- Preferably the control means comprises two separate controllers, one for each of the first and second rams, and it will be convenient to mount these controllers one on each of two arm rests which are formed by or mounted on the support frame.

- 55 Since each ram will retract automatically when the control means is switched to the appropriate exhaust position if the weight of the person is properly distributed on the chair, the rams need only be single acting, requiring the supply of compressed air only when being extended to raise the leg rest or the back and head rest. Sufficient compressed air for extending each ram as and when desired can be supplied by a few strokes of a hand pump, for example a bicycle pump, or alternatively

- 65 a small compressor or cylinder of compressed air may be mounted on the frame for this purpose. For example, a cylinder approximately 23 inches by 7 inches (approximately 58 cms. by 18 cms) charged to 150 p.s.i. (approximately 10.3 bar) would weigh only 6 1/2 lbs (approximately 3 kilograms) and should provide at least 150 operations, enough for several days use, before needing to be recharged.

- 70 Preferably the seat portion is pivotally mounted on the support frame so that it is suspended below the pivot axis. This means that the seat will effectively swing about the pivot axis, lowering the centre of gravity and moving it forwards as the seat reclines, which makes the chair safer and also reduces the load on the first ram in the reclined position.

- 80 Furthermore, the chair is preferably provided with a restoring spring, preferably one at each side, which is stressed as the seat reclines. This spring will act to slow the rate at which the seat reclines and also to assist the first ram in restoring the seat to the upright position, thus reducing the pressure needed to extend the first ram. Preferably the restoring spring acts between the seat portion and the support frame, and the attachment position of the spring to the seat portion relative to the pivot axis is preferably adjustable to suit the weight of the person using the seat so that the seat will only just tilt backwards when the occupant leans back against the back and head rest and operates the control means to allow air to escape from the first ram. The spring relieves some of the stress on the first ram, thereby making the chair safer, and also makes the operation of the chair slower and smoother, which increases the confidence of the user.

- 100 Preferably, the chair is provided with a catch, preferably one at each side, for locking the seat portion relative to the support frame when the seat portion is in a substantially horizontal position, thus holding the seat steady while a person gets on or off the chair. Preferably the catch is arranged to engage automatically when the seat portion is moved back to the horizontal position from a reclined position, and needs to be released by positive action in order to allow the seat to recline. This may be effected by means of a lever connected to the catch, but in some cases it may be convenient to arrange for the catch to be released in response to operation of the control means to permit escape of air from the first ram when the seat is to be reclined.

- 115 In order to ensure that reclining commences upon such operation of the control means (and release of the catch if provided), a tilt initiating spring may be provided which is slightly stressed when the seat portion is in the horizontal position. After the seat has tilted backwards slightly, this spring is no longer stressed and tilting continues under the weight of the occupant and against the force of the restoring spring mentioned earlier. The tilt initiating spring may be connected between the seat portion and the frame, and in a preferred example is attached to an extension of the seat portion projecting rearwardly of the back and head rest. Alternatively this spring may be conveniently located within the cylinder of the first pneumatic ram so that it is arranged to be

stressed by the piston as the ram nears full extension.

- If desired, the back and head rest may be articulated to the seat portion so that, with the seat portion locked in the horizontal position, the back and head rest can be lowered and raised relative to the seat portion by retraction and extension of the first ram, thus enabling the chair to be converted to a bed as and when desired. During normal operation of the chair however, the back and head rest remains at a substantially constant angle with respect to the seat portion (extending upwards and slightly rearwards when the seat portion is horizontal) and is preferably biased towards this upright position by a spring, preferably one at each side of the chair, acting between the seat portion and the back and head rest. In a preferred example this spring acts between the rear extension of the seat portion and the lower end of a rod which is connected to the back and head rest and extends downwardly through a guide opening in the extension. Since the spring biases the back and head rest to its upright position relative to the seat portion, it will be stressed if the back and head rest portion is lowered into the bed position, and will therefore assist the first ram in restoring the back and head rest to the upright position in much the same way as the restoring spring mentioned earlier assists the ram in restoring the seat to the horizontal position from a reclined position. Preferably, the chair will be provided with a catch for locking the back and head rest in the normal upright position relative to the seat portion. This catch must be released in order to allow the back and head rest to be lowered relative to the seat portion, and is preferably releasable only when the seat portion is locked in the horizontal position. If desired, the chair may be provided with a further catch for locking the back and head rest in the lowered position (i.e. in the bed position) relative to the seat portion.
- The second pneumatic ram acting on the leg rest preferably acts between the leg rest and the seat portion rather than the frame, and in this case the ram preferably acts on the leg rest through a bracket which is connected to the underside of the leg rest and projects below it so that the inclination of the ram relative to the seat portion remains substantially constant during operation of the chair and irrespective of the position of the leg rest relative to the seat portion. It is considered that the leg rest will usually be operated only when getting into and out of the chair, being raised immediately after sitting in the chair, and being lowered just before getting out. In order to avoid relying on maintaining the air pressure in the second ram to keep the leg rest raised, a ratchet mechanism may be provided which allows the ram to extend to raise the leg rest but prevent retraction, and hence lowering of the leg rest, until the ratchet is disengaged. In this case it may be possible to arrange for disengagement of the ratchet to be effected by operation of the control means to release air from the second ram when the leg rest is to be lowered.
- Preferably the support frame is mounted on

- wheels so that the chair is mobile and can therefore be moved easily while a person remains sitting or reclining in the chair. Indeed, a chair in accordance with the invention may be constructed as a form of wheelchair by making the rear wheels sufficiently large to be propelled by the occupant, and making the front wheels castor mounted to facilitate steering. In this case each of the front wheels may be provided with a pneumatic ram for raising the wheels over a curb or step, each ram being retracted in its operative state and having its cylinder fixed to the frame so that its push rod is arranged to extend downwardly and in a rearward direction behind the front wheel. The push rod carries a friction pad for engagement with the ground and on actuation of the ram exerts a lift and a push on the front of the frame which raises the wheel over the curb or step. The two lifting rams are operated synchronously by supplying compressed air simultaneously to the cylinder from a common source controlled by a simple on/off controller, and each ram is provided with a retractor spring for retracting the push rod when the curb or step has been mounted and the controller is turned off to vent the cylinders.
- As will be appreciated, an adjustable reclining chair has been described which can be operated easily and with little or no effort and which can be made extremely light and inexpensively compared with existing adjustable reclining chairs. The chair should prove particularly useful for disabled and infirm persons, and especially in hospitals, homes, and other institutions where many such people may be cared for. In this case each person will be able to adjust the chair to his or her liking as and when desired, leading to much greater comfort and greatly reducing the need to call upon staff for assistance. This will be appreciated by both patient and staff, particularly when the chair is used outdoors. Furthermore, a chair in accordance with the invention which is constructed to double as a wheelchair will provide much more versatility and comfort than a conventional fixed seat wheelchair.

An example of an adjustable reclining chair in accordance with the invention will now be described with reference to the accompanying diagrammatic drawings, in which:

- Figure 1 is a side elevation of the chair in the sitting position with the seat portion substantially horizontal and the leg rest lowered; and  
 Figure 2 is a side elevation of the chair in the fully reclined position with the leg rest raised.

The chair illustrated comprises a rigid support frame comprising a base frame 1 and a pair of similar upright side frames 2 connected rigidly to the base frame 1 at opposite sides of the base frame. Each side frame 2 comprises front and rear members 3 and 4 connected at their upper ends by a cross member 5 providing the chair with a rearwardly sloping arm rest. The support frame is mounted on two pairs of wheels 6 and 7 carried by the base frame 1, the front pair of wheels 6 having a castor action, and the rear pair of wheels 7 being provided with a braking system (not shown). The chair is therefore easy to move around, and can

immobilised in any desired position by application of the brakes to the rear wheels 7.

The chair further comprises a seat comprising a seat portion 8 which is pivotally mounted on the support frame, a combined back and head rest 9 which is fixed to the seat portion 8, and a leg rest 10 which is pivotally connected to the seat portion 8 at its front edge. In more detail, the seat portion 8 is suspended between the side frames 2 of the support frame by means of a pair of links 11 which are fixed at their lower ends to opposite sides of the seat portion 8 and are pivotally connected at their upper ends to the insides of the front members 3 of the side frames so that the seat can swing about a pivot axis 12 defined by the pivotal connections of the links 11 to the members 3. The back and head rest 9 has a back rest portion 13 and a head rest portion 14 which is fixed at an angle to the back rest portion, and is fixed to the seat portion 8 such that when the seat portion is substantially horizontal as shown in Figure 1, the back rest portion 13 extends upwardly and rearwardly from the seat portion 8 with the head rest portion 14 extending upwardly and rearwardly from the back rest portion 13 and closer to the vertical than the back rest portion. As shown, the back and head rest portion is attached to the seat portion 8 rearwardly of the links 11 but forwardly of the rear edge of the seat portion 8 so that the seat portion has a part 15 extending rearwardly behind the back rest portion 13. The part of the seat portion 8 in front of the back rest portion, the back rest portion 13 itself, and the leg rest 10 are all cushioned as indicated at 16, 17 and 18, and the head rest portion 14 is provided with a head cushion 19 which is adjustable upwards and downwards on the head rest portion.

The chair further comprises a first single acting pneumatic ram 20 having its cylinder 21 attached to the rear of the base frame 1 and its push rod 22 attached to the back and head rest 9. Supplying compressed air to the cylinder 21 extends the ram 20 to push the back and head rest 9 upwards away from the base frame 1, thereby swinging the seat about the pivot axis 12 towards the horizontal position of the seat portion 8 shown in Figure 1, wherein a catch 23 at each side of the chair automatically engages to lock the seat portion 8 in the horizontal position. Each catch 23 comprises a lug 24 on the inside of the rear member 4 of the corresponding side frame 2, and a lever 25 which is pivoted on the rearwardly extending part 15 of the seat portion 8 and is biased to a position in which a leading cam edge 26 of the lever will engage the lug 24 as the seat portion swings towards the horizontal position, thereby deflecting the lever 25 until the lug reaches a notch 27 in the lever whereupon the bias moves the lever to engage the notch 27 over the lug 24 to prevent further movement of the seat portion. The lower end of the lever 25 is connected by a rod 28 to the lower end of a further lever 29 which is pivoted on the side of the seat portion 8 in front of the links 11 so that movement of the upper end of the lever 29 forwards will disengage the catch 23 when desired.

A second single acting pneumatic ram 30 is

mounted below the seat portion 8, having its cylinder 31 connected to the rearwardly extending part 15 of the seat portion and its push rod 32 connected to a V-shaped bracket 33 fixed to the underside of the leg rest 10. When the ram 30 is retracted, the leg rest 10 occupies a position approximately at right angles to the seat portion 8 as shown in Figure 1, and supplying compressed air to the cylinder 31 extends the ram to raise the leg rest 10 to a position in alignment with the seat portion 8 as shown in Figure 2.

The pneumatic rams 20 and 30 are operated by a pair of controllers 34 mounted on opposite arm rest 5 of the chair, one for each ram. Each controller 34 has a control lever having three operative positions, a first in which the cylinder of the corresponding ram 20 or 30 is connected to a cylinder 35 of compressed air carried on the rearwardly extending part 15 of the seat portion 8 in order to supply air under pressure to the ram cylinder to extend the ram; a second in which the pneumatic connections to both the ram and the compressed air cylinder 35 are closed in order to maintain the pressure in the ram cylinder and thereby stop the ram at the position reached; and a third in which the cylinder of the ram is connected to atmosphere in order to exhaust the ram cylinder and allow the ram to retract. Although not shown, the compressed air cylinder 35 is provided with a pressure control valve having a pressure indicating gauge for controlling the output pressure for operating the rams 20 and 30, and the cylinder 35 also has a charging inlet having a non-return valve so that the cylinder can be releasably connected to a compressor.

Finally, the chair also comprises a pair of restoring tension spring 36, one at each side of the chair. Each restoring spring 36 has its upper end attached to a screw clamp 37 which can be clamped in any desired position along the length of a slide 38 mounted on the side of the seat portion 8 forwardly of the links 11, and has its lower end 39 retained in a freely slidable manner below a slide 40 mounted on the base frame 1 parallel to the slide 38. In use the upper ends of the restoring springs 36 are clamped to the slides 38 at a position dependent on the weight of the person intending to use the chair. The centre of gravity of the pivoted seat is such that, with the catches 23 released, the seat will adopt a balanced position in which is very slightly reclined and the springs 36 are still relaxed. With a person sitting on the seat and leaning back against the back and head rest 9, the centre of gravity is shifted further back so that the seat will recline further to the position shown in Figure 2, and the upper ends of the restoring spring 36 are clamped at a position such that they will almost counter the rearward tilting moment when the seat is fully reclined and the restoring springs are extended as shown in Figure 2.

In use a person gets into the chair with the seat in the position shown in Figure 1, i.e. with the seat portion 8 locked in the horizontal position and the leg rest 10 lowered. If the seat is to be reclined, the levers 29 are pushed forward to release the catches 23 and the controller 34 for the pneumatic ram 20 is

moved to its third operative position in which the cylinder 21 of the ram 20 is exhausted to atmosphere. With the person leaning back against the back and head rest 9, the seat tilts gently rearwards at a speed determined by the venting of the cylinder 21 and the extension of the restoring springs 36 as the front of the seat swings forwards and upwards. On reaching the fully reclined position shown in Figure 2, or any desired intermediate reclining position, the controller 34 is switched to the second operative (stop) position to maintain the reclined position. If the leg rest 10 is to be raised, the occupant simply switches the controller 34 for the second pneumatic ram 30 to the first operative position so that compressed air is supplied to extend the ram until the leg rest 10 has been raised to be required position. The controller 34 is then switched to the second operative (stop) position. To return the seat to the upright sitting position shown in Figure 1, the controller 34 for the ram 20 is simply switched to the first operative position to pressurise the cylinder 21 to extend the ram. Because of the restoring moment exerted by the springs 36, relatively little pressure is required to extend the ram 20 in order to swing the seat back into the upright position. On reaching the upright position the catches 23 automatically engage to lock the seat in this position, and the occupant returns the controller 34 to the stop position. The leg rest 10 is then lowered by switching the appropriate controller 34 to its third operative position to exhaust the cylinder 31 and allow retraction of the ram as the leg rest 10 lowers under its own weight.

#### CLAIMS

1. An adjustable reclining chair comprising a seat portion which is pivotally mounted on a support frame so that the seat portion can rock about the pivot axis, a back and head rest connected to the seat portion, a first pneumatic ram acting between the frame and the back and head rest, a leg rest articulated to the seat portion and acted on by a second pneumatic ram, and control means for controlling the supply and release of compressed air to and from the first and second rams independently of each other.
2. A chair according to Claim 1, in which the seat portion is pivotally mounted on the support frame so that it is suspended below the pivot axis.
3. A chair according to Claim 1 or Claim 2, comprising a restoring spring which is stressed as the seat reclines.
4. A chair according to Claim 3, in which the restoring spring acts between the seat portion and the support frame, and the attachment of the spring to the seat portion is adjustable in position towards and away from the pivot axis.
5. A chair according to Claim 4, in which the attachment of the restoring spring to the support frame is also adjustable in position correspondingly to the adjustment of its attachment to the seat portion.
6. A chair according to any one of the preceding Claims, comprising a catch for locking the seat

portion relative to the support frame when the seat portion is in a substantially horizontal position.

7. A chair according to Claim 6, in which the catch is arranged to engage automatically when the seat portion is moved back to the horizontal position from a reclined position, and needs to be released by positive action in order to allow the seat to recline.

8. A chair according to Claim 6 or Claim 7, comprising a tilt initiating spring which is slightly stressed when the seat portion is in the horizontal position to bias the seat towards reclining.

9. A chair according to any one of Claims 6 to 8, in which the back and head rest is articulated to the seat portion so that, with the seat portion locked in the horizontal position, the back and head rest can be lowered and raised relative to the seat portion by retraction and extension respectively of the first pneumatic ram.

10. A chair according to Claim 9, comprising a spring which biases the back and head rest towards an upright position relative to the seat portion.

11. A chair according to Claim 9 or Claim 10, comprising a catch for locking the back and head rest in the upright position relative to the seat portion.

12. A chair according to Claim 11, comprising a further catch for locking the back and head rest in the lowered position relative to the seat portion.

13. A chair according to any one of the preceding Claims, in which the back and head rest comprises a back rest portion and a head rest portion which is fixed at an angle to the back rest portion.

14. A chair according to any one of the preceding Claims, in which the second pneumatic ram acts between the seat portion and the leg rest.

15. A chair according to Claim 14, in which the second pneumatic ram acts on the leg rest through a bracket which is connected to the underside of the leg rest so that the inclination of the ram relative to the seat portion remains substantially constant irrespective of the position of the leg rest relative to the seat portion.

16. A chair according to Claim 14 or Claim 15, in which the second pneumatic ram is provided with a ratchet mechanism which allows the ram to extend to raise the leg rest but prevents retraction, and hence lowering of the leg rest, until the ratchet is disengaged.

17. A chair according to any one of the preceding Claims, in which the chair comprises a pair of arm rests formed by or mounted on the support frame, and the control means comprises two separate controllers, one for each of the first and second pneumatic rams, mounted one on each of the two arm rests.

18. A chair according to any one of the preceding Claims, carrying a rechargeable cylinder of compressed air for supply to the first and second pneumatic rams under the control of control means.

19. A chair according to any one of the preceding Claims, in which the support frame is mounted on wheels so that the chair is mobile.

20. A chair according to Claim 18, constructed as a

wheelchair having castor mounted front wheels and rear wheels which are sufficiently large to be propelled by the occupant.

21. A chair according to Claim 1, substantially as described with reference to the accompanying drawings.

Printed for Her Majesty's Stationery Office by Courier Press, Leamington Spa. 10/1985. Demand No. 8817443.  
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.